

Operating Instructions



Emissions Analysis Measuring Instrument EAM 3.011 - S20

Program description



BOSCH

Bosch - Test Technology

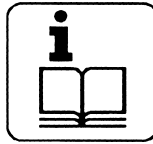
Certified Quality-Management-Systems according to DIN EN ISO 9001 by:



Reg. Nr.: 4066-01



Reg. Nr.: Z-1037-17



Before starting up and operating the unit, always read through the operating instructions and particularly the safety instructions thoroughly. In this way, you can avoid any uncertainties with respect to use of the unit, thus ensuring your own safety and preventing damage occurring to the unit.

All work on the engine, as well as the connection of testers in the engine area and on the ignition system, must be performed only when the engine is not running and the ignition is switched off.

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UK MOT approved for vehicles category A and B

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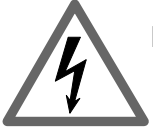
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Instructions for your personal safety and for the protection of equipment/vehicle components



Mains voltages High voltage



Hazardous voltages occur in both the lighting system and the electrical system of a motor vehicle. If contact is made with live parts (e.g. with the ignition coil), there is a risk of electric shock from flashover voltages caused by damaged insulation (e.g. ignition cables which have been attacked by martens). This applies to both the primary side and the secondary side of the ignition system, to the cable harness and the plug connections, to the lighting systems (Litronic) and to the tester connections.

Safety precautions:

- All testers must be connected to properly grounded, shock-proof sockets.
- Testers must always be connected using the power cables supplied with them.
- All extension cables must be fitted with shock-proof contacts.
- Any cables with damaged insulation must be replaced (e.g. power or ignition cables).
- Connect testers to the lighting system and switch them on before connecting them to the vehicle.
- Connect testers to the engine ground or to the battery (B-) before switching on the ignition.
- Always switch off the ignition before performing any work on the electrical system of the vehicle. The term "work" includes connecting testers, replacing parts of the ignition system, removing assemblies (e.g. generators), connecting assemblies to a test bench, etc.
- Wherever possible, tests and settings should always be carried out with the ignition switched off and the engine stationary.
- If tests or settings are carried out with the ignition switched on or the engine running, care must be taken not to touch any live parts. This applies to all the connecting cables of the testers as well as to the connections of any assemblies at the test bench.
- Test connections must always be made using suitable connectors (e.g. Set of Test Cables 1 687 011 208 or vehicle-specific adapter cables).
- Make sure that all test connections are properly plugged in and secure.
- Never open the casing of the screen.



Danger of acid burning in the respiratory system

When **exhaust gas measurements are taken, the sampling hoses** which are used release a highly caustic gas (hydrogen fluoride) that can cause acid burning in the respiratory system when heated to temperatures in excess of 250 °C (482 °F) or in the event of fire.

Safety precautions:

- Consult a doctor immediately after inhaling!



- Always wear gloves made of neoprene or PVC when removing combustion residues.
- Neutralize any residues left after a fire with a calcium hydroxide solution. This produces non-toxic calcium fluoride, which can be washed away.



Danger of acid burning

Acids and alkalis can cause severe burning on unprotected skin. Hydrogen fluoride forms hydrofluoric acid in combination with moisture (water).

The **condensate** which accumulates in the sampling hose and in the condensate container likewise contains acid.

When replacing the **O₂ sensor**, it should be remembered that it contains alkali.

Safety precautions:

- Rinse any affected parts of the skin immediately in water, then consult a doctor!
- The O₂ sensor is a hazardous waste and must be disposed accordingly. Bosch technical equipment suppliers are able to dispose of the sensors O₂ in the appropriate manner.

If liquid crystal escapes from a damaged **liquid crystal display**, it is imperative to avoid direct contact between the liquid and the skin, as well as inhalation or swallowing!

Safety precautions:

- Wash the skin and clothing thoroughly with soap and water if it comes into contact with liquid crystal.
- Consult a doctor immediately after inhaling or swallowing liquid crystal.



Danger of asphyxiation

Car exhaust fumes contain carbon monoxide (CO) - a colorless, odorless gas. If inhaled, carbon monoxide causes an oxygen deficiency in the body. Extreme caution is therefore essential when working in a pit, as some of the components of the exhaust gas are heavier than air and settle at the bottom of the pit.

Caution is also necessary when working on LPG-driven vehicles.

Safety precautions:

- Always ensure effective ventilation and suction (especially when working in a pit).
- Always switch on and connect the suction plant in a closed area.



Danger of injury

Danger of crushing



If the vehicle is not prevented from rolling away, there is a danger of people being crushed against a workbench, for example. Both running and stationary engines have rotating and moving parts (e.g. belt drives) which may cause injuries to fingers and arms. A special hazard is presented by electrically driven fans, in that they may be switched on without warning while the engine is stationary and the ignition is switched off.

There is a danger of tripping over the protruding rollers, the connecting cables and the power cable of the test system.

Do not place heavy objects on or lean on the sensor holder, because there is a danger of it breaking and falling on your feet.

Safety precautions:

- Take steps to prevent the vehicle from rolling away while it is being tested.
Select the park position if the vehicle has an automatic transmission and apply the handbrake or lock the wheels with chocks (wedges).
- Keep well away from rotating/moving parts while the engine is running.
- When working on or in the vicinity of electrically driven fans, allow the engine to cool down first, then disconnect the plug of the fan motor.
- Keep the tester connecting cables well away from all rotating parts.
- Lock the brakes on the test system trolley so that it cannot roll away.
- Lay the connecting cables in such a way that no-one can trip over them.
- Do not place heavy objects on or lean on the sensor holder.



Danger of burning

When working on a hot engine, there is a risk of injury from burning if such components as the exhaust gas manifold, the turbocharger, the Lambda sensor, etc. are touched or if parts of the body come too close to them. These components may be heated to temperatures of several hundred degrees Celsius. Depending on the duration of the exhaust gas measurements, the sampling probe of the exhaust gas measuring instrument may also become extremely hot.

Safety precautions:

- Always wear protective clothing, e.g. gloves.
- Allow the engine to cool down first (this also applies to auxiliary heating systems).
- Keep the tester connecting cables well away from all hot parts.
- Do not leave the engine running any longer than necessary for the test or setting.



Noise

Noise levels in excess of 70 dB(A) can occur when measurements are carried out on a vehicle, especially at high engine speeds. Damage to hearing may result if human beings are exposed to noise at such levels over an extended period of time.

Safety precautions:

- If necessary, noise protection facilities must be provided by the owner at all workplaces in the vicinity of the testing area.
- If necessary, suitable personal noise protection facilities must be used by the operator.

1. General Information

1.1 Application

The **E**missions **A**nalysis **M**easuring Instrument (EAM) is used for measuring the emissions (of smoke) from diesel-engined vehicles.

1.2 Who it is made for

The Emissions Analysis Measuring Instrument has been built for trained, expert personnel in the automotive sector. In order to ensure your own safety and to prevent damage to the equipment as a result of improper use, please read the information in these Operating Instructions carefully.

1.3 Guarantee

Never carry out any modifications to our products. Furthermore, KH-PR products must only be used in conjunction with genuine accessories.

Non-compliance shall render all terms of the guarantee void.

Despite having taken the utmost of care while programming, compiling and checking we cannot guarantee for the accuracy of the operating software (SystemSoft).

1.4 Description of the unit

The design, operation and method of connecting the unit to the vehicle can be found in the separate Operating Instructions.

Emissions Analysis Measuring Instrument Description of the Unit

IA4-UBF 957/1 1 689 981 664

1.5 Operating the RTM 430 Opacimeter

A basic description of the RTM 430 opacimeter covering its design, operating instructions, maintenance, technical data and scope of delivery, is contained in the RTM 430 Operating Instructions manual supplied:

Opacimeter RTM 430

IA4-UBF 956/1 1 689 979 651

1.6 Publication entitled "Connecting Test Systems to the Vehicle"

Useful information concerning the connecting of test systems and their sensors can be found in the following publication:

Connecting Test Systems to the Vehicle

KH-PR UBF 550/1 En 1 689 979 625

1.7 Definitions of terms

Effective measuring length:

- The effective measuring length is the light segment through which the smoke passes. It has a length of 430 mm. The determined measured values are converted as a function of the length of the measuring chamber.

Absorption coefficient (k factor) [m^{-1}]

- The absorption coefficient is a measure of the amount of light absorbed by the soot, white smoke and blue smoke related to 1 m light segment. Therefore, this coefficient is independent of the used unit.

2. The Basics

2.1 The display

The display consists of a 2-line LCD with 16 characters per line. This means that a number of words must be abbreviated. Long instructions are displayed as moving-letter displays that repeatedly run across the screen. The display is backlit and this function can be switched on and off by means of the key combination **SHIFT + I**.

2.2 What the keys mean

- The cursor keys are used for selecting options in menus (Standard mode) or for moving the cursor (Edit mode).

➔ Menu selection or move cursor one character to the right.

➔ Menu selection or move cursor one character to the left.

- Confirmation key

ENT Confirming menu selection or input, or progressing through the test program.

- Cancel key

ESC Cancel the current program step and return to the main menu.

- Delete key

DEL Menu selection to the right like ➔ (Standard) or deletes the character to the left of the cursor (Edit mode).

- Shift key

SHIFT Switches over to the second level of key assignments (input of the yellow characters). Shift only applies to the next character.

- Space bar

SPACE Inserts a blank.

- Number keys

0 - 9 Keys for entering numbers

• Decimal point

- Letters keys

A - Z Keys for entering letters

SHIFT + <Key with yellow lettering>

Key combination for entering the special yellow character

- Special function keys

For storing measured values (for continuous measurement and checking only).

SHIFT + I Key combination for switching the back-lighting on and off.

SHIFT + ENT Key combination for "one step back"

2.3 Program control

2.3.1 The Program or Operation mode

For the most part, control of the program consists simply of confirming the test steps specified. This is done using the top keys on the hand-held control unit. If there are several menu items or selection options to choose from, this is indicated by means of selection arrows < and > in the 2nd line. In such cases, the left menu can be selected using the ➔ and ➔ cursor key sand the right menu or another setting option using the or **DEL** key.

2.3.2 Input or Edit mode

Values or texts that can be changed can be changed in Input mode. There are 2 possibilities:

● The field is empty; no input has been made so far

- The type of input is identified by the flashing cursor on the left of the input field. Characters can be entered directly.

● The content of the field flashes; inputs have already been made

- In this case, the entry can be overwritten directly. When the first character is entered, the old entry is deleted completely and the new character you have entered appears together with the cursor.

- You want to delete, add to or change the old entry. The cursor is not yet visible.

DEL Deletes the entry and the cursor appears on the left.

➔ The cursor appears under the 1st character and this can be overwritten.

➔ The cursor appears after the least character and characters can be added.

As soon as the cursor is visible, you are in Input or Edit mode and are able to move the cursor by means of the cursor keys in order to change individual characters. The keys have the following meaning:

←	Move cursor one character to the left.
→	Move cursor one character to the right.
DEL	Deletes the character to the left of the cursor and the remaining characters are shifted to the left.
ESC	Rejects the changes and displays the old content again as a flashing display. The cursor disappears.

2.4 RPM measurement



The engine and ignition must always be switched off before any work is carried out on the ignition system.



Before performing RPM measurement (engine-speed measurement), always connect the B- clamp of the battery connecting cable (B+/B-) to vehicle earth.



Only ever connect one engine-speed sensor. The system automatically selects the engine-speed sensor connected.

Set the number of pulses and cylinders in accordance with the source used for picking up the engine speed (RPM).

2.4.1 The clip-on sensor

● Measuring point



Clip-on sensors are wearing parts.



The points listed below must always be observed when handling clip-on sensors, so that damage to the foil in the clip-on sensor and therefore failures can be avoided and the service life of the pickup can be extended.

- The clamping point must be perfectly smooth.
- The clip-on sensor must not be rotated after being clamped with the securing clip.
- Only use a clip-on sensor that matches the diameter of the injection tubing. If the diameter of the clip-on sensor is too large, it is not possible to measure the engine speed (RPM). If the diameter of the clip-on is too small, the pickup may be irreparably damaged.
- Never use emery paper or other tools to clean the clip-on sensor.

Connecting to the Emission Analysis Measuring Instrument:

- Connect the clip-on sensor connecting cable to plug-in socket 2 of the Emission Analysis Measuring Instrument (see Description of the unit).
- Connect the Emission Analysis Measuring Instrument (plug-in socket 1, see Description of the unit) to vehicle earth using clamp B- of the battery connecting cable (B+/B-) in order to achieve equipotential bonding during RPM measurement (engine-speed measurement).

Preparing the measuring point:

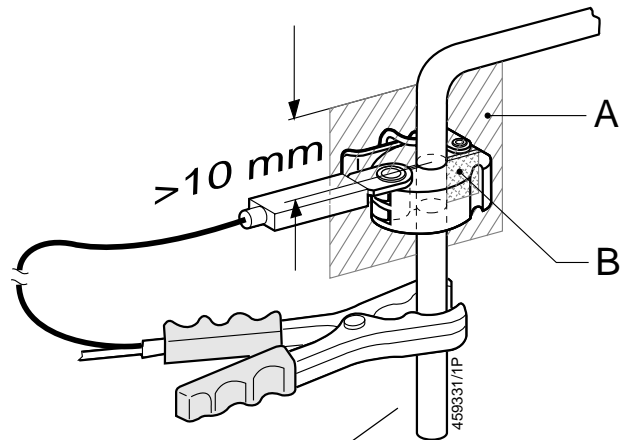
- The clearance between the clip-on sensor and the next bend in the tubing must be at least 10 mm.
- Clean the clamping point in a straight section of the injection tubing using sandpaper.
- The metal at the clamping point must be bare and must be totally smooth (no dents etc.). Remove the insulation from around insulated injection tubing.

Connecting to the vehicle:

- Determine the diameter of the injection tubing and select an appropriate clip-on sensor. The standard clip-on sensor KG6 (6 mm) is enclosed. If the car in question has injection tubes with a different diameter, you can order appropriate clip-on sensors (available as special accessories).
- Connect the clip-on sensor to the connecting cable (blade receptacle).
- Connect the black clamp of the connecting cable to vehicle earth.



Only use a clip-on sensor that matches the diameter of the injection tubing.



If the injection tubing is too thin, clamp the clip to the next metal part available.



The clip-on sensor must not be rotated around the injection tubing after being clamped. The clip-on sensor must be clamped onto the injection tubing in such a way that it does not make contact with any other components (wires, hoses, engine etc.).

- Clamp the clip-on sensor onto the cleaned section of injection tubing as shown in the figure. When making the connection, injection tubing level **A** must flush with the the switching surface (level **B**) of the clip-on sensor.

● Number of pulses

The number of pulses used for RPM measurement (engine-speed measurement) using a clip-on sensor depends upon the type of engine. The number of pulses must be set accordingly:

- with a 4-stroke engine, 1 pulse
- with a 2-stroke engine, 2 pulses

2.4.2 The TDC sensor

● Measuring point

If the vehicle manufacturer has installed a TDC sensor in the vehicle or there is a hole provided for fixing the workshop TDC sensor to be used, RPM measurement (engine-speed measurement) can be carried out using this sensor.

- Connect the vehicle-specific TDC-sensor connecting cable to plug-in socket 3 of the Emission Analysis Measuring Instrument (see Description of the unit) and to the vehicle.

● Number of marks

The number of pulses used for RPM measurement (engine-speed measurement) using a TDC sensor depends upon the type of TDC-sensor system.

You must know how many pins or notches there per 360° rotation of the crankshaft.

2.4.3 The RIV sensor

● Measuring point

- Connect the RIV sensor to the injection pump.
- Connect the connecting cable of the RIV sensor to plug-in socket 2 of the Emission Analysis Measuring Instrument instead of the clip-on sensor connecting cable (see Description of the unit).

● Number of pulses

The number of pulses used for RPM measurement (engine-speed measurement) using an RIV sensor depends upon the type of engine. The number of pulses must be set accordingly:

- for 4-stroke engines: pulse number 1
- for 2-stroke engines: pulse number 2

2.4.4 RPM measurement (engine-speed measurement) by means of alternator residual ripple (battery connecting cable B+/B-)


The battery connecting cable (B+/B-) is used to measure the engine speed (RPM) of compression-ignition (diesel) engines by means of the vehicle electrical system.

● Functional description


The engine speed (RPM) is measured by evaluating the residual ripple of the alternator output voltage. This signal is, however, superimposed by interference. To be able to detect the useful signal amongst this interference, an adaptation phase of approx. 15 to 30 seconds is required before the measurement phase.

● Measuring procedure

- Switch off the engine.
- Using the battery connecting cable (B+/B-), connect the VSM (plug-in socket 1, see Description of the unit) to the vehicle battery. The battery connecting cable is protected against polarity reversal.


 When working on a 24-V vehicle electrical system, connect to 24V! Do not connect the VSM just to one of the 2 batteries. The voltage range is from 9 to 32 V. When working on a vehicle with a number of independent batteries (e.g. a camping bus), connect the battery connecting cable (B+/B-) to the battery that is charged directly by the vehicle alternator.

- Set the number of cylinders accordingly.
- Start the engine and accelerate briefly so that the charge indicator lamp in the vehicle goes out.


 Switch on the vehicle lights and if fitted the rear heated window.
Switch off the blower and other consumers.

- Leave the engine running at idle speed.
- The engine speed (RPM) measured can be checked in the "Engine preconditioning and prechecks" test step.

The engine speed (RPM) measured is displayed after approx. 15 to 30 seconds.

 If RPM measurement (engine-speed measurement) does not result in a value being displayed, first check whether the polarity of the connections is correct.

You can now perform a test rev-up.

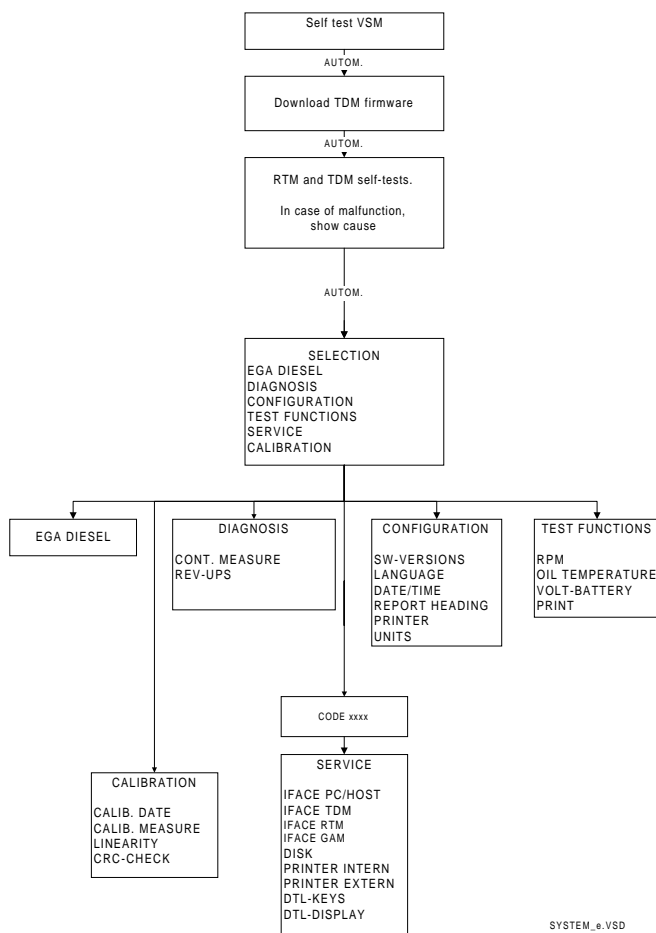
 The engine must be at normal operating temperature!

When performing the test rev-up, watch the breakaway speed. If the breakaway speed displayed is plausible and stable, the engine speed (RPM) measured by means of the alternator's residual ripple is correct. If not, you must choose a different method of measuring the engine speed (RPM).

2.5 Program and menu overview

When you switch on the Emission Analysis Measuring Instrument (EAM), the software first of all carries out a self-test. Afterwards, the main menu appears containing 6 menu items (selection options) that are selected using the cursor keys ← and → and confirmed by pressing the **ENT** key.

- EGA Diesel (Diesel exhaust-gas analysis test)
- Diagnosis
- Configuration
- Test functions
- Service
- Calibration



Each of these menu items is described in a separate section. Most of the menu items offer a submenu that contains further selection options.

The test procedures and setting/selection options are described below in detail with the aid of sequence charts.

2.6 The sequence charts

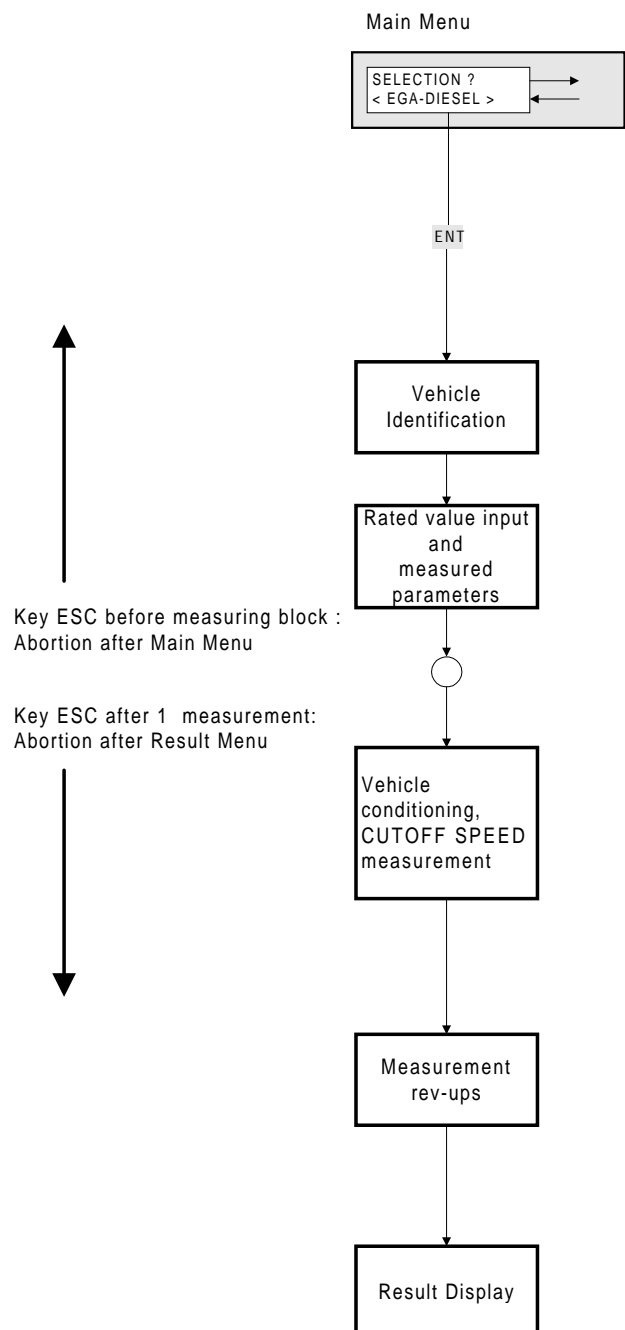
The sequence charts illustrated below show you the respective texts displayed on the hand-held control unit in rectangular boxes with two lines of text, single-lined boxes, as they are displayed in uppercase letters on the display.

The keys you need to press to move forwards and backwards in the sequence or to change or make inputs are marked by arrows in the text.

Lozenges, branching symbols etc. indicate program-internal sequences and decisions as specified either by the user or by statutory regulations.

2.7 Overview of the exhaust-gas test

The basic test sequence is shown in the following figure:



3. The EGA Diesel (Diesel exhaust-gas analysis test)

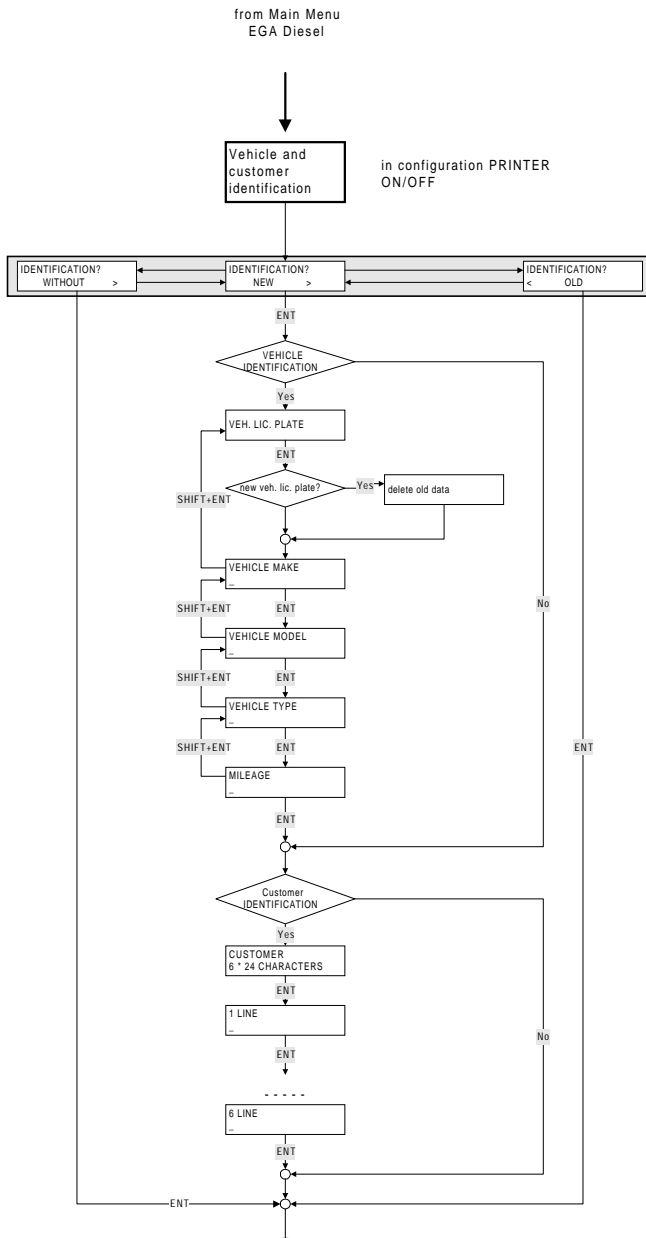
3.1 Vehicle and customer identification

This menu is where you enter data for identifying the vehicle and customer.

This data is then printed out together with the test result.

By pressing **SHIFT + ENT**, you can return to the previous input field; pressing repeatedly brings you back to the main menu. However, if you change the registration number, the program assumes that you are dealing with a new customer and automatically deletes all previous data.

Old The report printout contains the data last entered. It is not possible to make any changes.



There are three options for vehicle/customer identification:

None The report printout contains no details about the vehicle and customer.

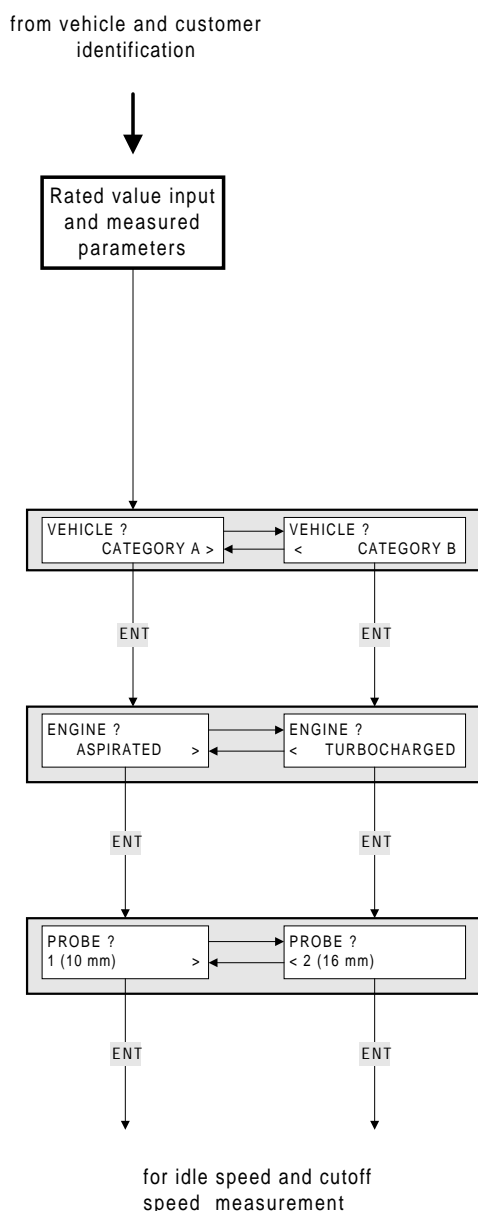
New The report printout contains the data that you input during the following procedures. Old customer data is not deleted; it is displayed and can be altered (see section 2.3.2, Input or Edit mode). By pressing **ENT**, you confirm an input and move on to the next input field.

3.2 Setpoint input and measuring parameters

Each exhaust-gas analysis test requires setpoints and measuring parameters. This data must be input into the exhaust-gas measuring system as reference values, so that the measured values can be compared and evaluated.

This data can be procured either direct from the vehicle manufacturer or importer, or purchased from institutes or publishing houses that compile the data from various vehicle manufacturers.

This data can be entered manually into the relevant input fields.



3.2.1 Selecting vehicle category

Using the arrow keys ← and →, select vehicle category A or category B.

3 to 6 measurement rev-ups are performed for category A vehicles.

4 to 10 measurement rev-ups are performed for category B vehicles.

By pressing **ENT**, you confirm an input and move on to the next input field.

3.2.2 Selecting engine type

In this input field, you must select the engine type "ASPIRATED" or "TURBOCHARGED" using the arrow keys ← and →. There are different limit values in the standard at this point for the respective categories. These are used correspondingly to evaluate the EGA.

By pressing **ENT**, you confirm the engine type selected and move on to the next input field.

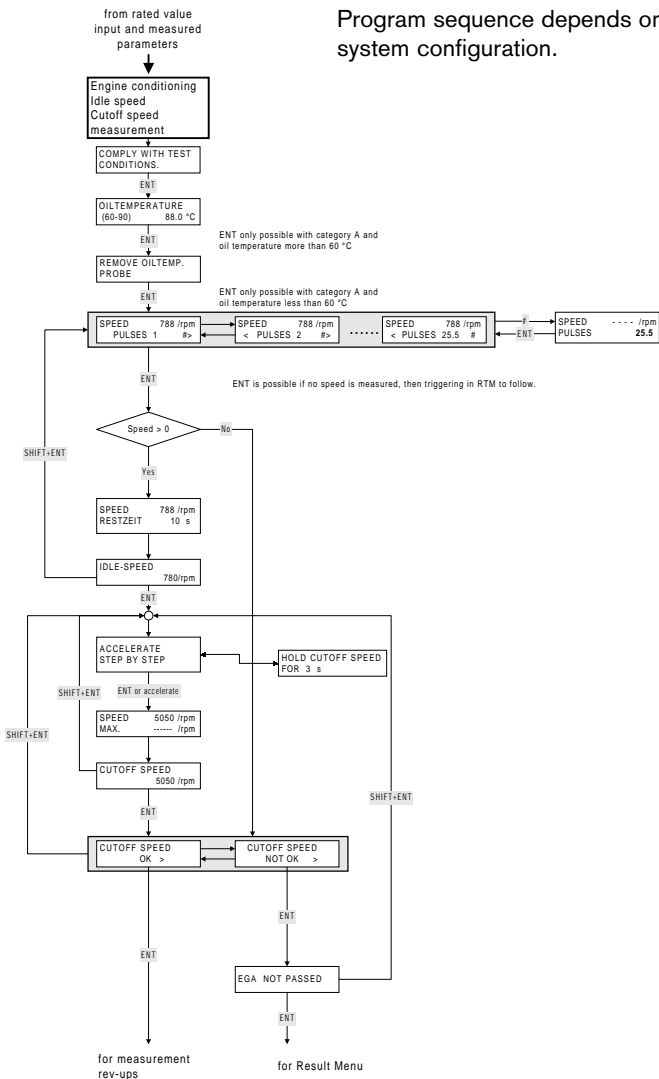
3.2.3 Selecting the probe to be used

The emission probe used must be selected with the arrow keys ← and →.

Probe 1 with a 10mm diameter or probe 2 with a 16mm diameter.

By pressing **ENT**, you confirm the probe type selected and move on to the next input field.

3.3 Engine preconditioning and prechecks



After the message “COMPLY WITH TEST CONDITIONS” and acknowledgement with **ENT**, you will see a prompt in the display requiring you to enter the oil temperature.

- Enter the oil temperature and confirm it by pressing **ENT**.

With category A and oil temperature more than 60 °C it is possible to skip oil temperature input by pressing **ENT**.

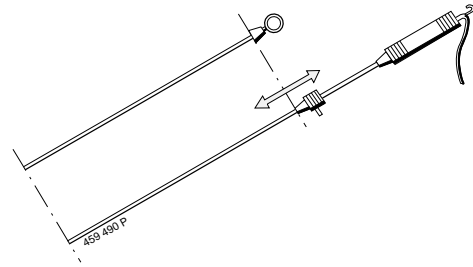
- Bringing the engine up to normal operating temperature

! If the engine is not brought up to the specified operating temperature, there is a danger of it being damaged by carrying out the exhaust-gas analysis test. Apart from that, all the measured values subsequently gained may possibly be incorrect.

To check that the engine temperature has reached the specified value, use the oil-temperature sensor to measure the oil temperature (prescribed only for category A vehicles).

- Connect the oil-temperature sensor to plug-in socket 5 of the VSM.

- Adjust the immersion depth of the oil-temperature sensor to match that of the oil dipstick (see figure).



- Insert the oil-temperature sensor instead of the oil dipstick.
- The engine-oil temperature is displayed.
- Remove the oil-temperature sensor (**ENT** only possible with category A and oil temperature less than 60 °C).

- Selecting the number of pulses and cylinders

To measure the engine speed (RPM), you must select the correct number of pulses and cylinders to match the engine being tested. This enables the rotational speed of the engine-speed sensor connected to be identified. For details, see section 2.4, RPM measurement (engine-speed measurement).



Before performing RPM measurement (engine-speed measurement), always connect the B- clamp of the battery connecting cable (B+/B-) to vehicle earth.

Use the arrow keys \leftarrow/\rightarrow to select the number of pulses or cylinders

1, 2, 3, 4, 5, 6, 8, 10, 12, 16, 288.

You can freely edit the number of pulses by pressing the # key

- Confirm the number of pulses by pressing **ENT**.

- Measuring the breakaway speed

This measuring step is not obligatory and can be skipped by pressing **ENT**.

Starting from idle speed, accelerate the engine carefully up to breakaway speed.

! To avoid damaging the engine, accelerate the engine slowly up to breakaway speed. If the max. tolerance is exceeded, abort the procedure immediately!

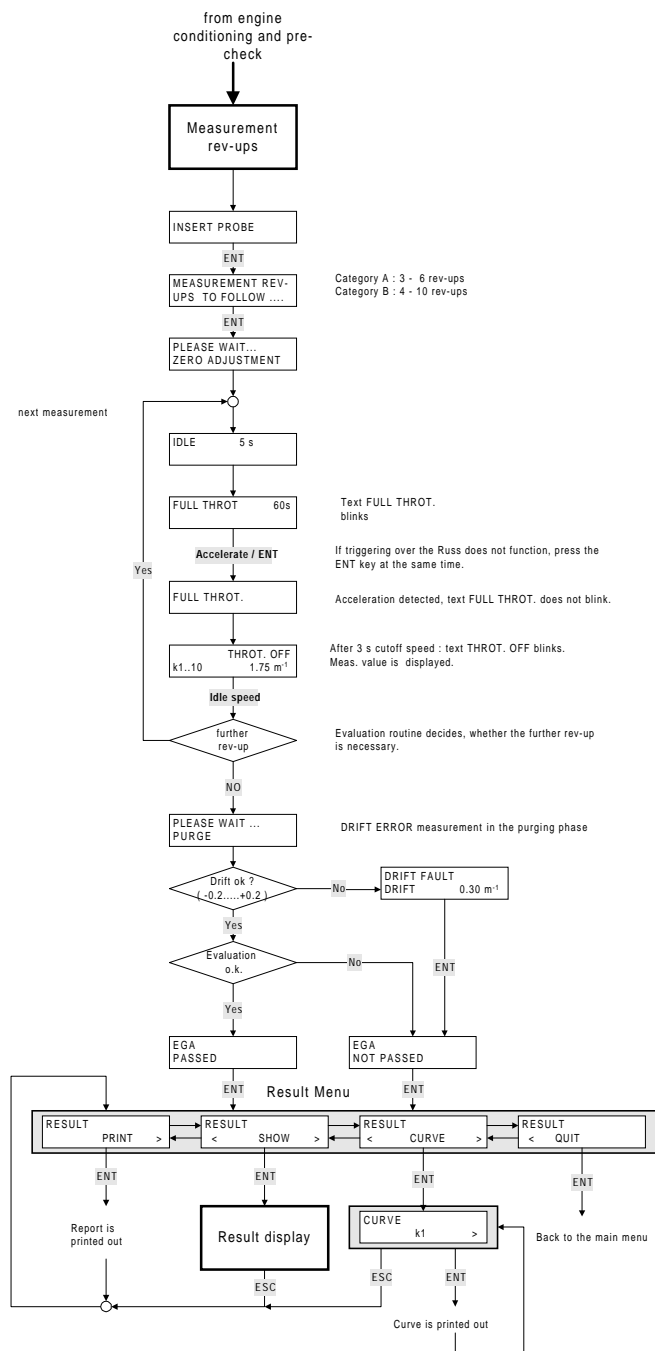
The breakaway speed is now measured over a period of 3 seconds and a mean value is calculated.

If the breakaway speed is o.k., confirm it by pressing **ENT**. The rev-up measurement is then started automatically.

If the breakaway speed is not o.k., confirm this by pressing the cursor keys **←** and **→**, and then press **ENT**.

The message "EXHAUST-GAS ANALYSIS TEST NOT PASSED" appears in the display.

3.4 Rev-up measurement



The prompt "INSERT PROBE" will be displayed before the measurement rev-ups.



Caution! Hot probe!

The exhaust-gas probe may still be very hot from being used beforehand for testing a different vehicle.

Insert the exhaust-gas probe into the exhaust pipe and make sure that it is seated securely.

Then confirm the prompt by pressing **ENT**.

The following information is displayed:

"PURGING AND MEASUREMENT REV-UPS WILL FOLLOW".

Press **ENT**.

If necessary, zero adjustment will be carried out.

After waiting for 5 seconds (Idle), you will receive the prompt "FULL THROT".

Push the accelerator pedal to the floor quickly and without "jolting" and hold it there until the prompt "RELEASE" appears.

After a short evaluation period, the result of the first measurement appears.

The evaluation is different for category A vehicles and category B vehicles.

● Category A vehicles

At least 3 measurement rev-ups are carried out.

If all measured values are $< 2.00 \text{ m}^{-1}$, then no further evaluation is carried out and the measurement is deemed passed.

If not all measured values are $< 2.00 \text{ m}^{-1}$, the mean value of the last 3 measurements is calculated. The lowest turbidity factor of these 3 measured values must be greater than or equal to 75% of the mean value.

If the measurement is not valid, another measurement rev-up is carried out. The new mean value of the last 3 measurements is then calculated.

Up to a maximum of 6 measurement rev-ups are carried out.

If the maximum number of measurement rev-ups is reached, the following rule applies:

If a turbidity value is $< 75\%$ of the mean value, this value is rejected and the new mean value is calculated from the remaining measured values. This will be repeated until no turbidity value is $< 75\%$ of the mean value.

If the measurements are within the prescribed tolerance range, "EGA PASSED" appears on the display. Confirm this by pressing **ENT**.

● Category B vehicles

At least 4 measurement rev-ups are carried out.

If all measured values are $< 2.00 \text{ m}^{-1}$, the mean value of the last 4 measurements is calculated. The lowest turbidity value of these 4 measured values must be greater than or equal to 75% of the mean value.

If the measurement is not valid, another measurement rev-up is carried out. The new mean value of the last 4 measurements is then calculated.

Up to a maximum of 10 measurement rev-ups are carried out.

If the maximum number of measurement rev-ups is reached, the following rule applies:

If a turbidity value is $< 75\%$ of the mean value, this value is rejected and the new mean value is calculated from the remaining measured values. This is repeated until no turbidity value is $< 75\%$ of the mean value.

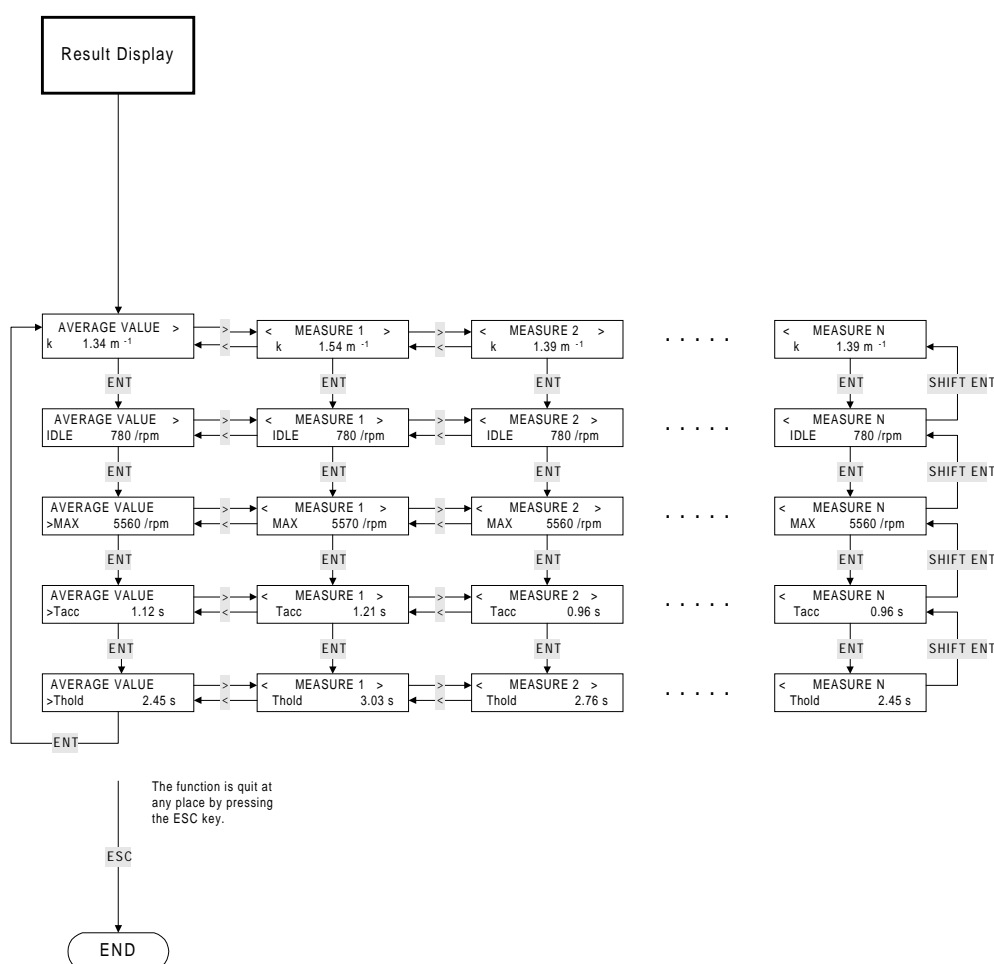
If the measurements are within the prescribed tolerance range, "EGA PASSED" appears on the display.

Confirm this by pressing **ENT**.

The following options are then displayed:

- Print out measurement result
- Display measurement result
- Print out curve
- End test

3.5 Display measurement results



In the menu "Result Display", the mean values and all measurements of the following parameters can be displayed:

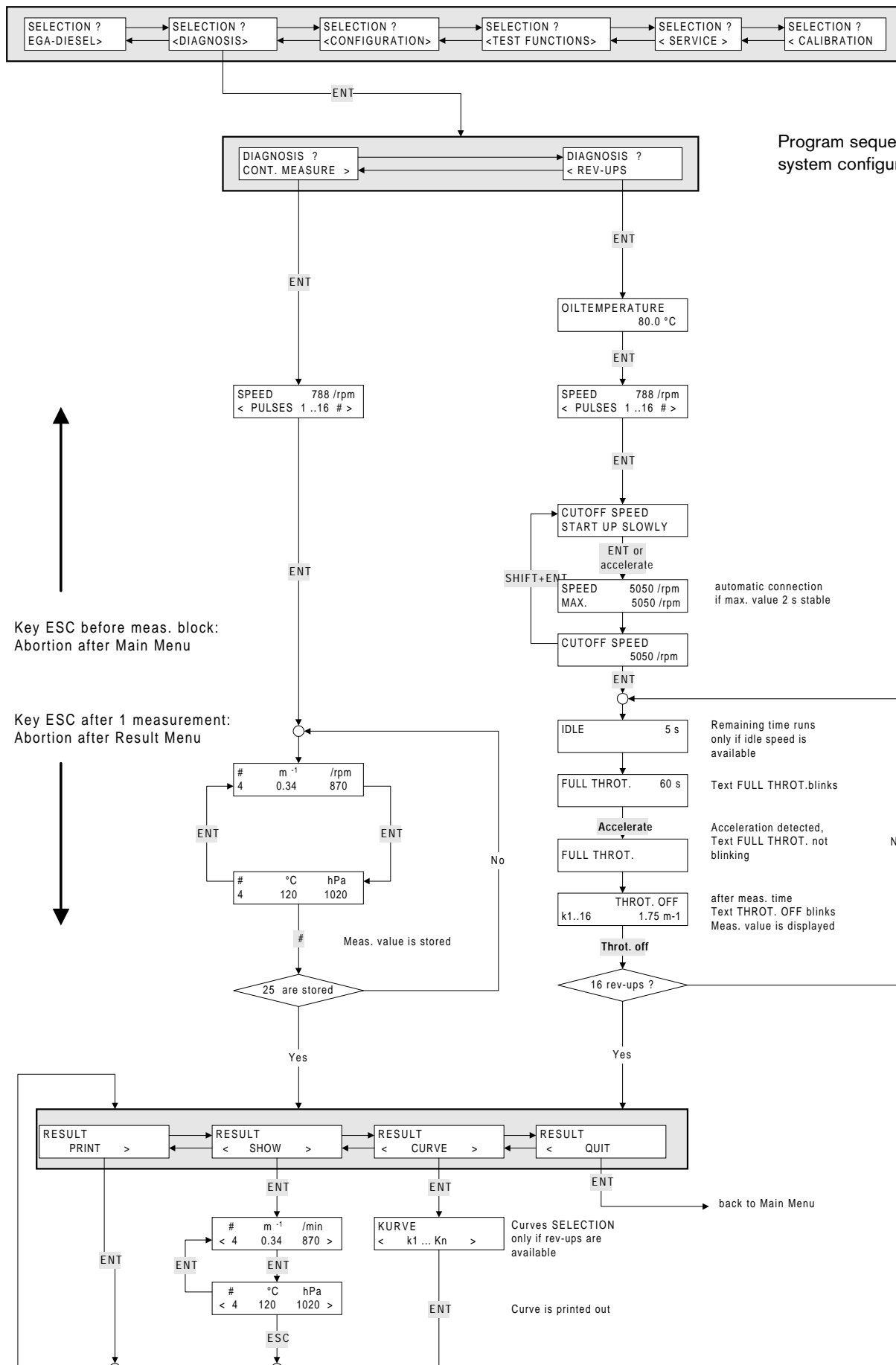
- Turbidity value
- Idle speed
- Cutoff speed
- Acceleration time
- Hold time

You can toggle between the average value and the measured values using the arrow keys \leftarrow and \rightarrow .

ENT can be used to move from one parameter to the next.

ESC cancels the display of measured results.

4. The "Diagnosis" Menu



In the "DIAGNOSIS" menu, you have the choice of two types of measurement: "CONTINUOUS MEASUREMENT" and "FREE ACCELERATION".

Use the cursor keys ← and → to make your selection and confirm it by pressing **ENT**.

4.1 Continuous measurement

Procedure:

- Connect the engine-speed sensor to the vehicle.
- Start the engine and if necessary warm it up.
- Insert the exhaust-gas probe into the exhaust pipe and make sure it is seated securely.



Caution! Hot probe!

The exhaust-gas probe may still be very hot from being used beforehand for testing a different vehicle.

You then select the number of pulses and cylinders (proceed as described in the passage "Selecting the number of pulses and cylinders" in section 3.3 "Engine preconditioning and prechecks").

The current engine speed (RPM) is also displayed at the same time.

After selecting, confirm the inputs by pressing **ENT**.

You can now carry out up to 25 measurement rev-ups at different engine speeds (RPM).

Once the engine has reached the desired speed, press the # key to store the measured value. The measurement is then stopped by pressing **ESC**.

Using the cursor keys ← and →, you can then display or print out the measured values or end continuous measurement completely. Confirm your selection by pressing **ENT**.

4.2 Free acceleration

This procedure is used to measure the exhaust-gas values, e.g. when adjusting the engine. The k values are not evaluated and no purging rev-ups are carried out.

A maximum of 16 measurement rev-ups can be carried out.

If you want to stop carrying out measurement rev-ups before you reach 10 times, press **ESC** or ignore the "FULL THROTTLE" prompt (i.e. do not rev up the engine); the program will then detect time-out after a specified delay has elapsed.

At the end of the measurements, you can use the cursor keys ← and → to display or print out the measured values, print out curves which show the opacity and engine-speed values plotted against time, or end this type of measurement completely.

Confirm your selection by pressing **ENT**.

5. The "Configuration" Menu

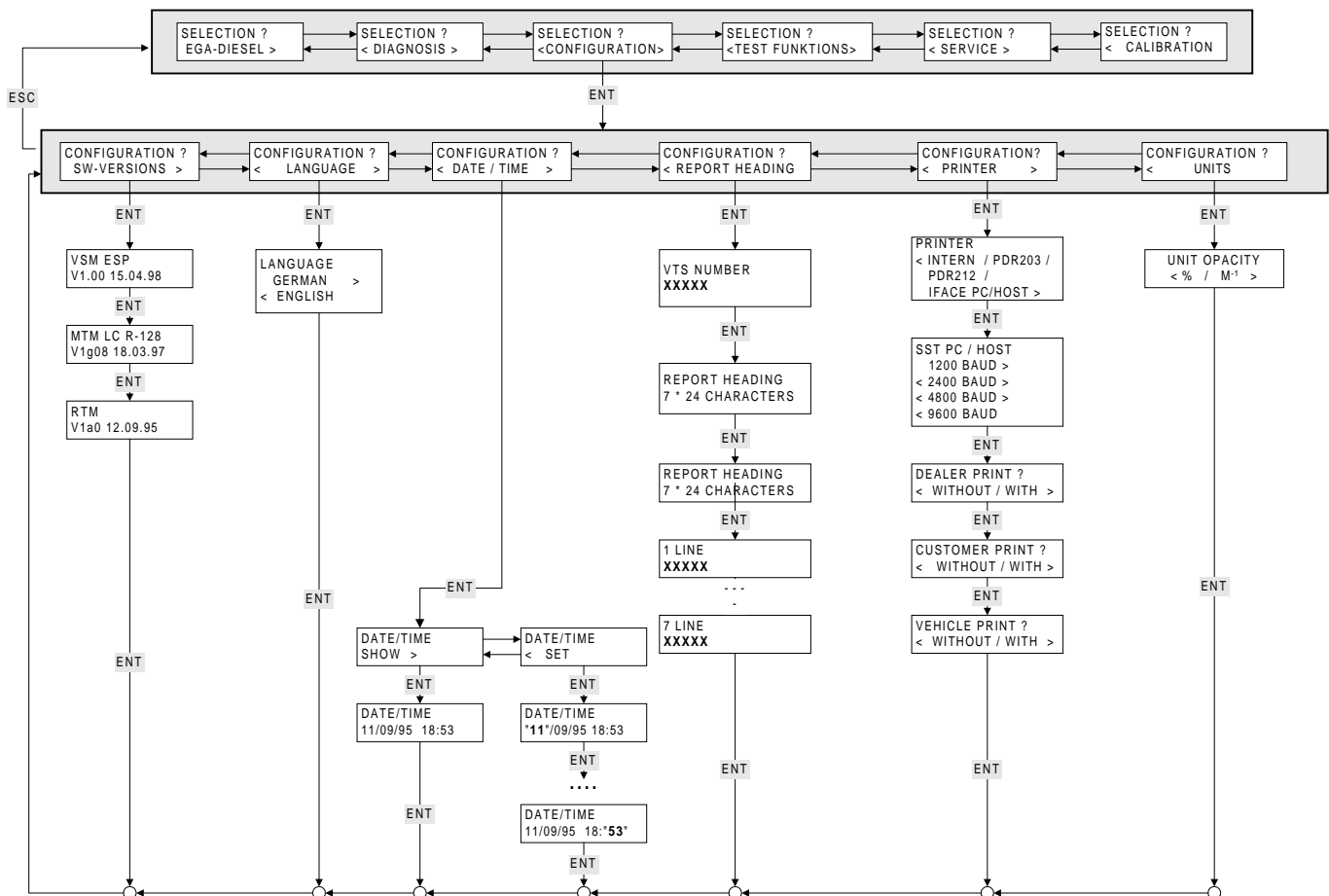
5.1 Overview

The "CONFIGURATION" menu allows you to read out information such as the software version and to enter or change settings such as the date/time. You have the choice of the following submenu items (see figure):

- SW VERSION
- LANGUAGE
- DATE/TIME
- REPORT HEADER
- PRINTER
- UNITS

Pressing **ENT** always returns you to the menu.

Important : Only when leaving the configuration by pressing the ESC key the changes are accepted.



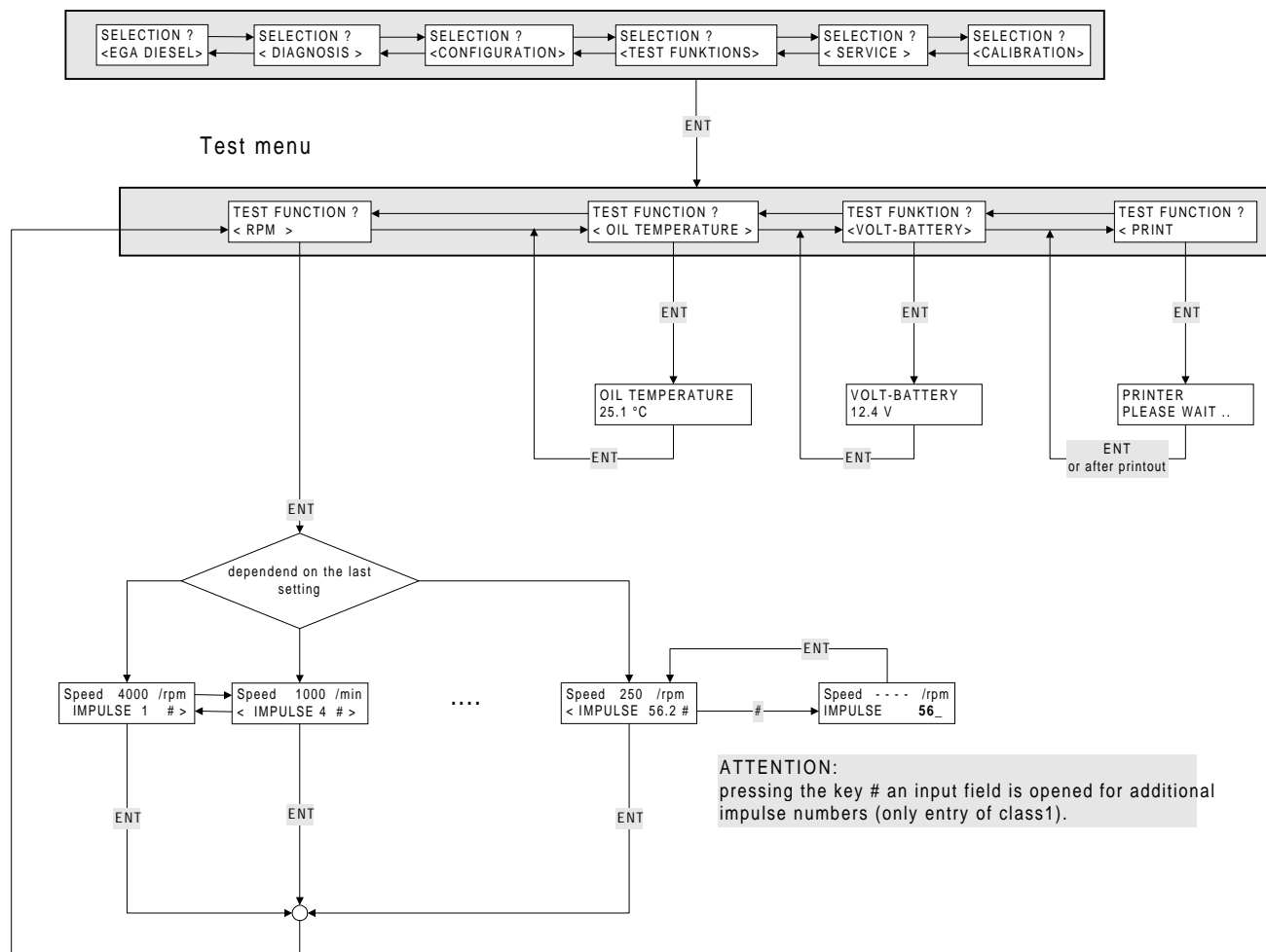
6. The "Test Functions" Menu

6.1 Overview

The "TEST FUNCTIONS" menu enables you to use the system like a simple measuring unit, i.e. without test procedures. The following measurements are possible:

- RPM
- OIL TEMPERATURE
- BATTERY VOLTAGE
- PRINT

Pressing **ENT** always returns you to the menu.



With the **ESC** key back to the Main Menu

6.2 Engine speed (RPM)

The engine speed (RPM) is displayed continuously. Using the cursor keys **←** and **→**, you can select the number of pulses of the engine-speed sensor depending upon the engine to be tested.

6.3 Oil temperature

The temperature is displayed continuously in °C.

6.4 Battery voltage

The battery voltage is displayed continuously in volts (V).

6.5 Print

A test print containing the date, time and all printable characters is printed.

7. The "Service" Menu

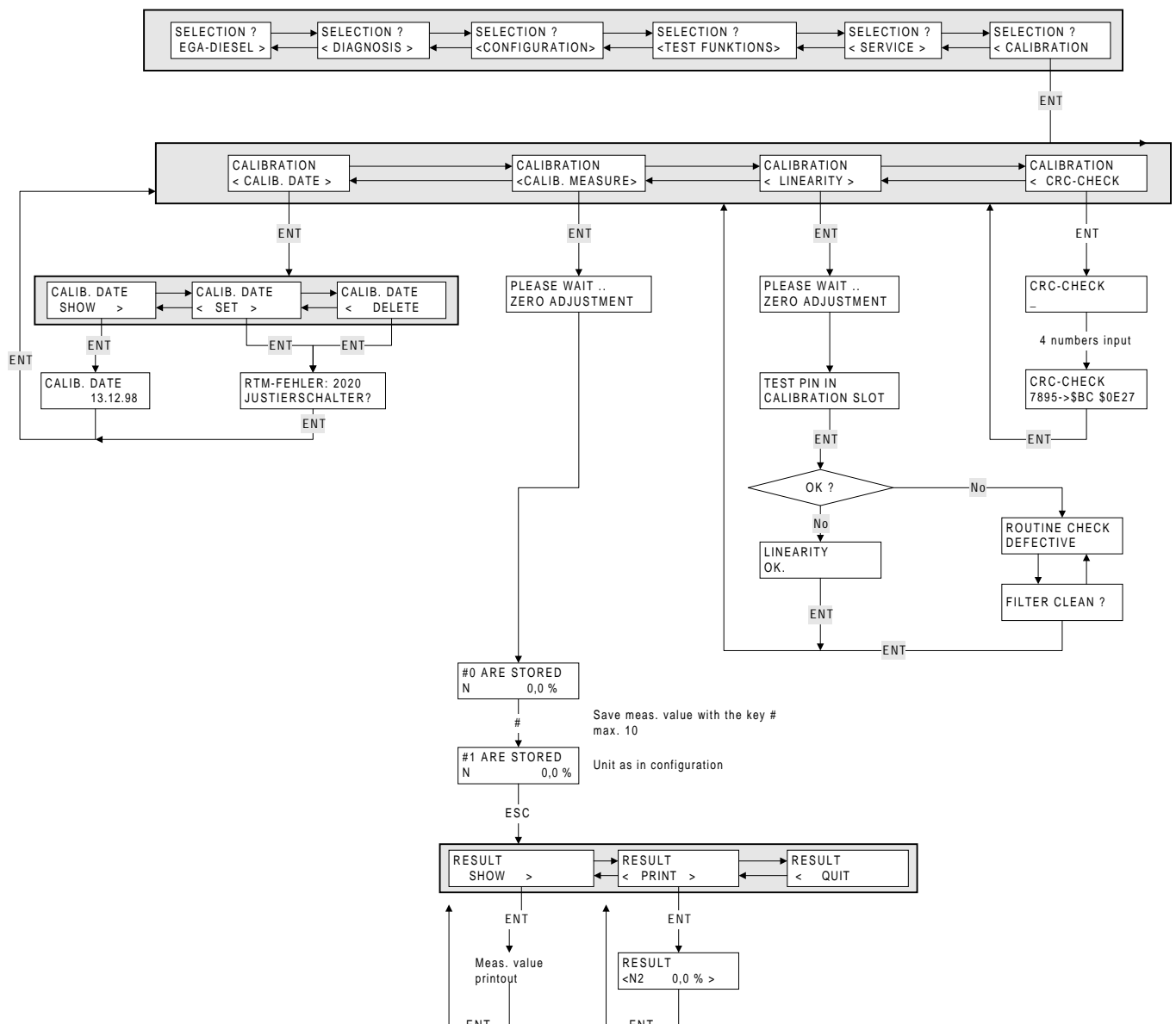
The submenu accessible from the "SERVICE" can only be reached by entering a code. Only authorised After-Sales Service staff can access this submenu.

8. The "Calibration" Menu

8.1 Overview

The "CALIBRATION" menu allows you to read information such as the calibration date and to check and change settings such as the CRC check. You can choose from the following submenu items (see also figure entitled "CALIBRATION MENU").

- CALIBRATION DATE
- CALIBRATION MEASUREMENT
- CHECK (linearity check)
- CRC CHECK



8.2 Calibration date

The "Calibration date" submenu gives the choice between "DISPLAY", "SET", and "DELETE". In the first case, the last calibration date is displayed and cannot be changed. The other two options are only for authorised staff (e.g. the staff of the calibration agency). In both cases, an error message is displayed.

RTM error: 2020

Command presently not available. (Adjustment switch?)

ENT returns you to the submenu.

The calibration date is stored in the RTM. To calibrate the system, the calibration seal must be broken and the calibration switch in the RTM must be pressed. After calibration has been completed, the calibration switch must be reset and a new seal attached.

After the RTM opacimeter has been calibrated, the procedure must be concluded with the menu item "Set calibration date".

8.3 Calibration measurement

The RTM is balanced (zero-adjusted) etc. and then continuously displays the opacity in % and m^{-1} .

This measurement is performed with the measuring chamber closed and without exhaust-gas temperature compensation.

8.4 Check

The RTM is balanced (zero-adjusted) etc. first. The user then sees the following prompt:

***** Please insert test pen into calibrating plug-in socket.**

Confirm by pressing **ENT**.

If an error is found during the linearity check, the following message and question to the user are displayed:

***** Routine check fault. Filter been cleaned ?**

If the linearity check is run through successfully, **OK** is displayed. In both cases, pressing **ENT** returns you to the "Calibration check" menu.

8.5 CRC check

This function is solely for use by the staff of the calibration agency when checking the integrity of the system.

The user reaches an input field in which the cursor is visible. As soon as the user has entered 4 digits, the associated checksum appears. **ENT** returns you to the submenu.

9. Error Messages

If an error arises when switching on during a test procedure or for some other reason (e.g. calibration is necessary), it is displayed by means of 2 pieces of information.

- Error number: 4-digit number in the 1st line
- Error text: normally moving-letter display

The following table lists the individual errors with number, error text and remedy if it can be performed by the user. In all other cases, please contact **After-Sales Service**. This also applies to error numbers that are not listed in the table.

2000	Transmitter / receiver dirty	Clean transmitter and receiver
2001	Measured value rise is too small	Clean transmitter and receiver
2002	Supply voltage fault	Check power supply cables
2003	Purging-air curtain error	After-Sales Service
2004	Check required	Inform calibrating agency
2005	EPROM checksum wrong	After-Sales Service
2006	EPROM checksum wrong	After-Sales Service
2009	Too much light on receiver	After-Sales Service
2010	Valve faulty	After-Sales Service
2011	Exhaust-gas temperature sensor faulty	After-Sales Service
2012	Measuring-chamber Temperature sensor faulty	After-Sales-Service
2013	D/A converter faulty	After-Sales Service
2020	Command presently not available	After-Sales Service
2030	Transmission fault	Switch unit off and back on again

10. Maintenance

10.1 Checking display accuracy

- Starting from the Start mask

SELECTION ?
← EGA DIESEL →

- Press the → key 5 times.

The display displays:

SELECTION ?
CALIBRATION

- Press **ENT**.
- Press the → key 2 times.

The display displays:

Calibration
CALIBRATION MEASUREMENT →

- Press **ENT**.

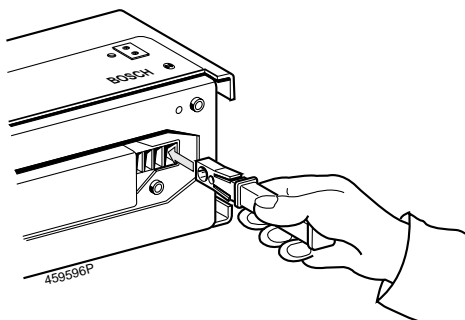
The display displays:

PLEASE WAIT...
ZERO ADJUSTMENT

After approx. 1 minute, the display displays:

0 STORED
N 0.0 %

- Insert the calibrating pen into the calibrating plug-in socket of the receiver end (on the underside of the unit).



The display displays the following text (example):

OPACITY
50.8x % 1.63x m⁻¹

The measured opacity value must be between 45 % and 55 % or 1.40 m⁻¹ and 1.80 m⁻¹. If a measured value is displayed that is not within this tolerance, the RTM opacimeter must be serviced in-house (see Operating Instructions RTM 430 AT-PR UBF 956/1, Part Number 1 689 979 651).

After servicing, the check using the calibrating pen must be repeated.

If servicing does not lead to the desired effect, contact your Bosch After-Sales Service representative.

10.2 Maintaining the calibrating pen

Remove any dust deposits on the calibrating pen using a bellows-type lens brush (as used for cleaning camera lens).



Under NO circumstances use compressed air, because this would damage the calibrating pen.

Emissions-Analyse-Meßgerät

EAM 3.011 - S20

0 684 103 120



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